18. Explain the principles of conservation of linear and angular momentum, discussing their importance in mechanics and providing examples of applicable systems. Illustrate your answer with relevant diagrams if necessary.

19. Explain how to calculate the frequencies of normal modes from the transformed equations.

20. Derive the Lorentz transformation equations. Discuss their significance in transforming coordinates between two inertial frames moving at a constant relative velocity.

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APRIL/MAY 2025

23PPH12 — CLASSICAL MECHANICS AND RELATIVITY

Shanmuga Industries Arts & Science College T.V.Malai

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. What are generalized coordinates and why are they used in mechanics?

2. State the conservation laws for a system of particles.

3. Define the Lagrangian formulation for a spherical pendulum.

4. List out the applications of Atwood's Machine.

5. Define phase space.

6. Write Hamilton's canonical equations of motion.

7. Define stable equilibria.

8. How are the normal modes of vibration can be defined for a linear triatomic molecule?

9. What is meant by inertia frame?

10. Represent the four vectors (position, velocity, momentum, acceleration, force) and their notation.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Differentiate holonomic and non-holonomic constant.

Or

(b) What is the principle of virtual work? Derive the equation of motion for a particle using this principle.

12. (a) Apply the Lagrangian formulation to derive the equations of motion for a simple pendulum.

Or

(b) Illustrate the application of Lagrangian mechanics to Projectile motion.

13. (a) Define cyclic coordinates and discuss their significance in the Lagrangian formulation. Illustrate your answer with a suitable example.

Or

(b) Explain the motion of a particle in a central force field using Hamiltonian mechanics.

14. (a) Derive Lagrange's equation for a system undergoing small oscillations.

Or

(b) Describe the parallel pendulum and analyze its motion.

15. (a) Write a short note on Mishowshi's Space

Or

(b) Describe the relativistic addition of velocities.

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SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions

16. Derive the transformation equations in the context of generalized co-ordinates. How do they relate to the physical coordinates of a system, and what role do they play in classical mechanics?

17. Using Lagrangian mechanics, derive the equations of motion for a compound pendulum. Discuss how the moment of inertia about the pivot point affects the dynamics of the system.